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Attempts to include geomagnetic anomalies into the existing Romanian Operational Earthquake Forecast

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Our study analyzes the possibility to include geophysical parameters in the existing OEF (Operational Earthquake Forecasting) application based on the geochemical detected anomalies correlated with short-term changes in seismicity rates and occurrence of medium sized intermediate depth earthquakes.

The study aims to decide which of the geomagnetic anomalous signals can be considered to be a reliable precursor of Vrancea, Romania moderate sized earthquakes that occurred in the last decade. The anomalies were observed using different processing methods: polarization, diurnal variation, differential analysis between two stations or simple visualization at only one station and the standard deviation from the mean value.

The existing OEF application for the Vrancea area based on geochemical parameters is using the standard deviation, time gradient, cross correlation, and linear regression customized for the geological specificity of the area under investigation. For anomaly detection is used the short-time-average through long-time-average trigger (STA/LTA) method on time-integral data. The daily-seasonal variation of parameters is correlated with atmospheric conditions and temperature in the borehole to avoid false decisions. The probability and epistemic uncertainty of the gas emissions act as input into a logical decision tree.

During the study period, in Vrancea seismogenic zone there have been recorded 25 earthquakes with moment magnitude $M_w > 4.5$, at intermediate depth. The Geomagnetic data are obtained from Muntele Rosu (MLR) Seismological Observatory and Plostina (PLOR) of NIEP, situated inside Vrancea seismogenic zone as primary station, and from Surlari (SUA) National Geomagnetic Observatory, part of the International Real-time Magnetic Observatory (Intermagnet), as remote station, unaffected by medium size earthquake preparedness processes. We have assumed that the zone of effective manifestation of the precursor deformations is a circle with the radius taken from the equation of Dobrovolsky, 1979. Geomagnetic indices taken from GFZ (<https://www.gfz-potsdam.de/kp-index>) were used to separate the global magnetic variation from possible local seismo-electromagnetic anomalies, that might appear in a seismic area like Vrancea zone and to ensure that observed geomagnetic fluctuations are not caused by solar-terrestrial effect.

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